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Cash and Tax Evasion

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Abstract

Cash and Tax Evasion

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Economists and public policy experts contend that paper currency facilitates tax evasion. However, due to the illicit nature of tax evasion, limited empirical evidence exists to document or quantify this claim. I use the staggered implementation of the Electronic Benefit Transfer (EBT) program to identify a decrease in local cash circulation that holds constant the level of income to provide empirical evidence on the role of cash in tax evasion and offer magnitude estimates. The EBT program replaced cash-based government distributions with an electronic system. I use the staggered implementation of the EBT program across all states to estimate an increase in reported taxable income between $0.56 and $1.15 for every dollar replaced with electronic payment. Next, I use the staggered implementation in the state of Missouri to estimate an increase in reported taxable sales between $3.83 and $8.48 per replaced dollar. Overall, my results suggest that cash transactions are an economically significant means by which small businesses evade both income and non-income taxes. The results are of interest to academics and regulators as they seek to better understand the impact of cash circulation on tax compliance and evaluate policies to improve tax compliance.

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Chapter 1: Introduction

Economists and public policy experts argue that paper currency (i.e., Federal Reserve Notes) facilitates tax evasion because cash transactions are difficult for regulators to trace (Slemrod 2007; Morse, Karlinsky, and Bankman 2009).[1] However, providing reliable empirical support for this claim is challenging because it is difficult to measure both local cash circulation and concealed tax evasion. Therefore, while there is a general belief that small businesses use cash transactions to underreport income, limited empirical evidence and no precise estimates exist regarding the impact of cash on tax evasion. Consequently, tax enforcement agencies, policy makers, and academics are interested in better understanding the effect of cash on tax compliance. I contribute to this important public policy issue by using a novel setting to provide direct empirical evidence on the role cash plays in facilitating both non-income and income tax evasion and by producing estimates of the magnitude of the effect.

It is important to understand how cash contributes to small business tax evasion for at least three key reasons. First, small businesses are economically significant and the single largest contributor to the U.S. tax gap (the level of overall tax noncompliance). Small businesses create 43.5 percent of the private non-farm gross domestic product (GDP) (Kobe and Schwinn 2018) and use cash transactions as a means to underreport income (Bankman 2007). The most recent estimates available from the Internal Revenue

[1] Cash is sometimes used when referencing money as a transaction medium, whether digital or otherwise. I use the word "cash" throughout the manuscript to signify U.S. Federal Reserve Notes (i.e. "paper" currency).

Service (IRS) report a $441 billon gross tax gap for the years 2011-2013. The underreporting of business income by individuals is estimated at $110 billion or 29 percent of the total net tax gap.[2] This amount is larger than the tax gap of $37 billion attributed to all C-corporations, with large corporations accounting for $26 billion. Quantifying the factors that contribute to the underreporting of small business income is essential for regulators to design procedures that improve compliance and reduce the tax gap.[3]

Second, studying small business tax compliance is important because small firms' tax evasion tactics and opportunities differ from those employed by large firms. Small businesses have different disclosure obligations, financial statement audit requirements, and reporting incentives than those of large, publicly traded corporations. While all taxpayers have incentives to reduce taxable income, public corporations are limited by incentives to maintain their reputations and report higher income on their financial statements (e.g. Graham, Hanlon, Shevlin, and Shroff 2014; Chen, Chen, Cheng, and Shevlin 2010; Mills and Newberry 2001). Small businesses, being mostly privately held, generally do not prepare audited financial statements that are publically available. Thus, small businesses enjoy a greater opportunity to hide cash revenues without negative reputation effects or stock market pressures. Despite these important differences, the majority of the accounting tax-avoidance literature focuses on public corporations, in

[2] See https://www.irs.gov/pub/irs-pdf/p1415.pdf. Throughout this manuscript, "small business" refers to independent sole proprietorships, partnerships, and S-corporations having fewer than 500 employees, based on the definition used by the U.S. Small Business Administration for research purposes.
[3] See "That Stubborn Tax Gap" available at https://www.taxpolicycenter.org/taxvox/stubborn-tax-gap

part, because of data availability. Yet, evidence on small business tax compliance is useful and important to those who study, design, and enforce tax law.

Third, studying cash-based tax evasion is important because cash remains a prominent payment method despite the rise in alternative transaction methods. According to the 2018 Diary of Consumer Payment Choice, cash is the second most common payment instrument for personal transactions. Cash comprises 26 percent of personal transactions, behind only debit transactions with 28 percent. The use of cash is largely confined to in-person payments, which account for 88 percent of all non-bill payments. For in-person payments, cash remains the most common payment method at 35 percent of all transactions. In-person payments provide a greater opportunity for tax evasion because they produce no paper trail, which make the transactions easier to hide from enforcement agencies (Roth, Scholz, and White 1989).

Additionally, a single cash note can be underreported numerous times because taxpayers exchange cash multiple times annually. According to a survey by the Federal Reserve, cash is exchanged an average of between 50.4 and 55.2 times per year (Avery 1986). Feige (1989a) uses the estimates of currency velocity and banknote replacement from the Federal Reserve to estimate the turnover rate of each denomination. He estimates small (large) denomination notes are exchanged approximately 115 (21) times per year. These estimates suggest the potential for a multiplier effect of cash circulation on tax evasion.

To examine the impact of cash on tax evasion, I use the staggered implementation of the Electronic Benefit Transfer (EBT) program from 1993-2004 to capture variation in

cash circulation. The EBT program replaced the need for government welfare payments to be made in cash. Instead, the EBT system distributes government funds to recipients' accounts digitally, and the recipients can then use a debit card to pay for products using electronic terminals. The revenues small business taxpayers receive from an EBT card transaction are more difficult to underreport than from cash because of the associated electronic record. Using the staggered adoption of EBT program, I am able to identify changes to cash circulation that are plausibly exogenous to other economic factors that affect income.[4]

I use Allingham and Sandmo's (1972) theory on taxpayer compliance to predict that a reduction in cash circulation will cause an increase in tax compliance.[5] The theory states that a taxpayer's compliance is affected by the perceived detection probability. Taxpayers use cash to engage in anonymous and virtually untraceable transactions, which decreases the detection probability of associated tax evasion. However, a decrease in cash distribution may not cause an increase in compliance if recipients withdraw their benefits in cash or businesses adjust the percentage of the cash transactions they report. Ultimately, whether, and to what degree, a decrease in cash circulation will improve tax compliance remain open empirical questions.

[4] The change in cash circulation is plausibly exogenous to income levels because the objectives of the program were principally unrelated to tax evasion or economic activity. The central goals of the program were 1) to reduce the stigma associated with using food stamps 2) to ensure ease of benefit use 3) to reduce program fraud and 4) to reduce costs associated with mailing paper checks.

[5] There is a long history of tax evasion models that build upon Allingham and Sandmo's (1972) seminal paper. See Andreoni, Erard, and Feinstein (1998) and Slemrod (2019) for reviews on taxpayer compliance.

I first examine the impact of cash circulation on reported annual taxable income using the staggered adoption of EBT across the United States. The national EBT implementation took place from 1993-2004 and has been implemented in all U.S. states and the District of Columbia. I find economically and statistically significant increases in reported taxable income after EBT implementation. Specifically, I find reported taxable income is higher by about 0.5 percent or $80 per person per year. I estimate that replacing one dollar of cash payment with a digital payment on an EBT card increases reported taxable income between $0.56 and $1.15. [6] The multiplier effect comes from the fact that a cash dollar can be passed "underground" a number of times before it reenters the formal economy. The multiplier explains why a decrease in cash circulation of $1 can lead to an increase in reported taxable income greater than $1.

Next, I use the staggered adoption of EBT within the state of Missouri to examine whether a reduction in cash circulation also leads to a change in reported taxable sales. This setting is noteworthy for two reasons. First, it reduces concerns the results are impacted by factors other than EBT implementation because counties within a state are unaffected by policy differences across states. Second, it allows an estimate of the effect of cash on a non-income base, taxable sales, which Missouri reports quarterly.[7] It is valuable to estimate the impact on taxable sales because taxpayers are more likely to underreport taxable income if they also are able to hide the taxable sale, which would

[6] The range of estimates are derived using the amounts distributed under different programs included in the EBT system. I discuss these programs in detail in Section 2.

[7] I use the staggered, national implementation of EBT to estimate the impact on reported taxable income. I do not estimate income using a single state because income is reported annually and the Missouri implementation occurred within a twelve month period.

produce a verifiable paper trail through the sales receipt. Additionally, it demonstrates cash transactions affect both income and non-income (e.g. sales tax) tax evasion, an important distinction as not all jurisdictions administer each tax type.

I find, after implementation of digital payment transfers, which average $166 million per quarter, taxpayers in Missouri counties report taxable sales that are higher by 7.9 percent or $116 per person per quarter. This equates to a total increase of $637 million per quarter at the state level. I estimate that reported taxable sales increase between $3.83 and $8.48 for every dollar of payment replaced with digital payment.

I compare the findings on reported taxable income and reported taxable sales to corroborate the validity of the magnitudes of the two results. If small businesses do not report revenue from a transaction, they correspondingly do not report the associated expenses because doing so increases the risk the tax evasion will be discovered (Morse et al. 2009). I reason that when taxpayers begin reporting sales due to EBT implementation, they also begin reporting the related expenses. This assumption is also consistent with the finding of Slemrod et al. (2017) that small businesses increase reported receipts and expenses in response to their electronic receipts being reported to the IRS. This indicates the average small business profit margin in my sample period is about 14 percent. I assert this estimate is reasonable and validates the estimated magnitude of effects on reported income and reported sales from the two settings.[8]

[8] In 2017, the average profit margin for sole proprietorships in retail trade with net income was 13.91 percent according to data from the IRS. https://www.irs.gov/statistics/soi-tax-stats-nonfarm-sole-proprietorship-statistics

I perform several additional analyses to corroborate the main findings and provide supplementary evidence on the impact of cash circulation. First, I plot coefficients to provide evidence on pre-treatment trends. The results are consistent with reported taxable income not statistically increasing prior to EBT implementation. Second, I examine the effect of EBT implementation on more verifiable types of income and employment. I do not find evidence that EBT increased wages, dividends and interest, or employment, consistent with the effect being concentrated among small businesses.

Next, I examine the effect of cash circulation on capital allocation for small businesses. Because small businesses rely on tax returns to support loan applications, an increase in tax compliance can also lead to an increase of capital allocated to small businesses. Using data on small business loans from the U.S. Small Business Administration (SBA), I find loan amounts are statistically and economically larger after EBT implementation but there is no increase in the number of loans approved.

Finally, I proxy for cash circulation using the Federal Deposit Insurance Corporation (FDIC) National Survey of Unbanked and Underbanked Households. Underbanked households are more likely to rely on cash as a means of exchange relative to other transaction methods when compared to fully banked households (Apaam et al. 2018). Underbanked households use alternative financial services such as check-cashing services that provide cash payments.

I find that underbanked areas have lower levels of reported sole-proprietor income. Specifically, a one standard deviation increase in the percentage of the underbanked population (5 percentage points) is associated with a decrease of $150 in

reported income per business. Given an average of 77,718 sole proprietor returns filed per MSA-year, this translates to a decrease of $11.7 million in reported taxable income per MSA, or an average decrease of about one percent of reported income per sole proprietorship.

It is possible that regions with a higher underbanked population percentage have lower levels of true income that affect reported taxable income. To provide evidence this is not driving the results, I replace business income with three different types of income that are more verifiable and, therefore, unlikely to be impacted by cash circulation in a region: wages, interest, and dividends. As expected, I do not find a statistically significant association with any of these three income types. These results are consistent with the increased cash use in an area affecting only lower levels of reported small-business income.

The results of my study are of interest to academics, tax enforcement agencies, and policy makers. Enforcement agencies have limited budgets and need to understand taxpayer compliance behavior to efficiently assess and collect taxes. My evidence supports public policy experts' speculation that phasing out paper currency could "have a significant impact on discouraging tax evasion" (Rogoff 2017). Importantly, the results also demonstrate that improved tax compliance can be achieved without eliminating cash entirely. Instead, policy makers can incentivize the use of non-cash alternatives by providing digital welfare payments, increasing access to mobile banking, or providing accessible, low-cost bank accounts. My results suggest these measures would allow

communities to continue to use cash as needed, while meaningfully improving tax compliance.

Chapter 2: Background and Hypothesis Development

2.1 BACKGROUND AND PRIOR LITERATURE

Tax avoidance and tax evasion are prominent research areas in accounting and public economics literature. The extensive accounting literature on tax avoidance finds largely that firms' tax avoidance and reporting behavior responds to changes in disclosure requirements and public pressure (e.g. Hope, Ma, and Thomas 2013; De Simone 2016; and Dyreng, Hoopes, and Wilde 2016). The vast majority of this literature focuses on large, public companies (see Shackelford and Shevlin 2001; Hanlon and Heitzman 2010; and Wilson and Wilde 2018 for reviews of the literature). In part, this focus is the result of laws that require corporations to publicly disclose the amount of income tax they pay and owe, which allows researchers to estimate tax avoidance activity.

Despite the literature's focus on large public corporations' tax avoidance, it is valuable to study and understand small business tax compliance behavior, because small businesses represent an economically significant segment of the overall economy. Small businesses account for 43.5 percent of GDP and $1.03 trillion (27 percent) of U.S. individual non-wage income according to the most recent Statistics of Income (SOI) data available for the year 2017.[9] Additionally, small businesses are likely to be more aggressive in tax avoidance because they do not have the same incentives as public

[9] Data are available from https://www.irs.gov/statistics/soi-tax-stats-individual-income-tax-returns-publication-1304-complete-report#_IndReturns. The $1.03 trillion includes sole-proprietor ($346 billion) and partnership/S-corporation ($680 billion) entities. I include partnerships (S-corporations) because 73 (92) percent have assets under $1 million, indicating the majority are small businesses. There are three sources of individual income larger than individual business income: salaries and wages ($7.6 trillion), capital gains ($854 billion), and pensions and annuities ($729 billion).

companies to increase reported income for financial statement purposes (Hanlon, Mills, and Slemrod 2007). Therefore, their tax evasion activities are thought to contribute substantially to the tax gap.

The tax gap is the IRS estimate of the difference between the total taxes owed and taxes paid on time. The IRS began periodically estimating the tax gap in 1979 and continues to adapt the program to provide the most thorough and comprehensive estimates of tax noncompliance. The IRS develops its estimates by combining information from the National Research Program (NRP), formerly the Taxpayer Compliance Measurement Program (TCMP), with information from enforcement activities and focused research about a particular source of income, for instance, cash payments.

According to the most recent IRS estimates, the gross tax gap for the years 2011-2013 is $441 billion, which is almost 20 percent of the $2,242 billion of tax that is paid on time and voluntarily.[10] The tax gap is comprised of three broad types of noncompliance: non-filing ($39 billion), underpayment ($50 billion), and underreporting ($352 billion). Individual business income underreporting represents the single largest contributor to the tax gap, estimated at $110 billion or 29 percent of the total net tax gap. This is larger than the tax gap attributed to all C-corporations, with small and large corporations accounting for $11 billion and $26 billion, respectively. Therefore,

[10] The IRS eventually collects an additional $52 billion from enforcement efforts and late payments for a net tax gap estimate of $406 billion.

quantifying the factors that contribute to the underreporting of income for small businesses is important for designing remedies that can help close the tax gap.

In addition to helping improve tax revenue collection, improved compliance could lead to more efficient capital allocation. When small businesses seek capital funding, they generally rely on their tax returns to support loan applications. Consequently, income not reported on the tax return cannot support a bank loan and the taxpayer must rely on personal earnings and savings to fund needed operations. Properly allocating capital to small business is essential for the economy because the "self-employed, 14.6 million in all, represented 10% of the nation's 146 million workers, and they in turn provided jobs for 29.4 million other workers."[11] A better understanding of small-business tax evasion could curtail income underreporting that impacts capital allocation.

Policy makers and regulators argue that small businesses use cash transactions as a principal means to evade taxes. This view is consistent with the standard economic model of tax compliance formulated by Allingham and Sandmo (1972). They detail that tax compliance is impacted by a transaction's perceived detection probability, penalty for evasion, and tax rate. Because it is difficult for regulators to verify cash transactions, the detection probability of underreporting cash transactions decreases, which increases the utility and ability of taxpayers who use cash to evade taxes.

Cash remains a viable payment option despite advancements in cashless payment alternatives such as debit or credit cards, electronic funds transfers, and other online

[11] Pew Research Center analysis using U.S. Census Bureau data. https://www.pewsocialtrends.org/2015/10/22/three-in-ten-u-s-jobs-are-held-by-the-self-employed-and-the-workers-they-hire/

banking systems (PayPal, Venmo, etc.). According to the 2018 Diary of Consumer Payment Choice, cash is the second most common payment method that individuals use, at 26 percent of transactions, only behind debit transactions at 28 percent. Cash remains the most common method of payment for transaction amounts up to $50 and for all in-person payments. In-person cash payments provide a greater opportunity for tax evasion because they do not produce an auditable paper trail. Additionally, because a single cash note is used in multiple transactions through the course of a year, a note could be underreported in numerous transactions annually. According to a survey by the Federal Reserve, a cash note is exchanged an average of 4.2 to 4.6 times per month or 50.4 to 55.2 times per year (Avery 1986).

Estimating the impact of cash on tax evasion remains a difficult problem for researchers because of the nature of the activity. As Slemrod (2019) noted, "measuring tax evasion is highly challenging due to tax evaders' incentive to conceal their behavior." Tax evasion is illegal, so taxpayers necessarily conceal their actions to decrease the probability of detection. The concealment efforts of evaders limit the ability of interested parties to study and accurately evaluate tax evasion.

Prior literature provides evidence on the factors that influence taxpayer compliance. Allingham and Sandmo (1972) adapt the economics of crime model from Becker (1968) to provide the foundational economic model of tax compliance. Jackson and Milliron (1986) and Richardson and Sawyer (2001) provide a summary of factors that affect tax compliance, including age, sex, education, income level, income source, occupation, peer influence, ethics, fairness, complexity, IRS contact, probability of

detection, sanctions, and tax rates.[12] Among these factors, the most important determinant of tax compliance is income source.

Income source significantly influences taxpayer compliance because certain sources, such as income from small businesses, are more difficult for enforcement agencies to verify than wage or interest income. This difficulty is primarily caused by the lack of third-party reporting (e.g. a W-2 for wage income or a 1099-INT for interest income). IRS tax gap estimates are commonly cited as support for the importance of income source. Slemrod (2007) notes the "most striking and important aspect of (the tax gap) is the huge variation of misreporting…by type of income." The underreporting of verifiable types of income is relatively low: wages and salaries (one percent), pension annuities (three percent), and dividends (five percent). In comparison, estimated underreporting from non-farm small businesses is 56 percent, which represents almost a third of all individual income tax underreporting. Cash transactions contribute to the large underreporting of small businesses, but it is difficult to estimate precisely.

Several studies indirectly measure the total impact of cash on the entire underground economy. [13] Tanzi (1983) examines the ratio of currency to the total money supply (M2) in a regression framework.[14] He then calculates changes in the underground

[12] Additional factors that impact tax compliance include how taxpayers value public goods and political alignment. See Alm, McClelland, and Schulze (1992) and Cullen, Turner, and Washington (2018).
[13] Rogoff (2015) states "(t)he underground economy includes agents evading taxes, laws, and regulations. The size of the underground economy is not known within any precision…" and that "(e)ven with all of the Internal Revenue Service's effort to estimate the tax gap, there is of course a high degree of uncertainty about the exact size of the gap."
[14] The M2 is a money stock measure reported by the Federal Reserve. The M1 includes currency, traveler's checks, and demand deposits. The M2 includes the M1 in addition to savings deposits, small-denomination time deposits (less than $100,000) and balances in retail money market mutual funds.

economy using the ratio of currency to the M2 explained by changes in the tax level. He estimates the underground economy averages $30 billion per year or 4.24 percent of GNP from 1930 to 1980. This model has been adapted to estimate the underground economy in foreign countries as well (e.g. Hepburn 1992). Feige (1989b) details alternative estimates obtained using similar currency demand models that range between $217 and $422 billion for the year 1981. The estimates indicate about 20 percent of adjusted gross income (AGI) is unreported, which is consistent with the current IRS tax gap estimate. Although, prior studies do provide a rough estimate of the overall underground economy, their assumptions limit the implications for understanding how cash impacts tax evasion. Therefore, while these estimates may be informative, they are difficult to verify and "cannot provide much of a guidance for policy" (Tanzi 1999).

Perhaps the most direct evidence on how cash payments affect tax evasion is from qualitative analysis. Morse et al. (2009) conduct field study interviews with 273 individuals including, 92 cash business owners, 149 tax preparers, and 32 bankers to better understand who evades taxes, what taxes they evade, and how they evade. They find small businesses are less likely to report cash transactions because of a perceived low likelihood of detection and penalty. The revealed amount of underreporting could be remarkably high. When asked if small cash businesses report as little as 50 percent of their income, one interviewee responded "50%? No. I'd say 33%." Other interviewees

noted they underreport income to save on income and non-income-based taxes, such as sales tax.[15]

The authors find taxpayers rely on "parallel cash economies" to hide income. A parallel cash economy is a system where businesses do not report cash revenue, but they also do not report the associated expenses. They use the cash received to subsequently purchase supplies and inventory from their dealers off the books. Several accountants told the study's authors "If you are going to cheat, cheat on the income side or cheat on the deduction side, but not both." Their interviews confirm assumptions that small businesses do not report all of their gross income from cash transactions, and that cash is passed "underground" from business to business.[16] However, they cannot quantify the degree to which cash contributes to tax evasion.

I seek to add to our understanding of small business' tax compliance by examining the effect of cash on reported taxes. I examine the impact on total reported taxable sales because it affects both non-income and income-based taxes, and I examine taxable income because it affects income tax directly.

[15] Discussions with the Texas Associate Deputy Comptroller for Tax confirm that cash transactions can be difficult to trace. For example, many small businesses use multiple cash registers and direct all cash transactions through one register. Then they do not record or disclose any of those transactions for tax purposes. This type of evasion is generally only caught through in-person audits.

[16] The interview findings are also consistent with the empirical findings of Slemrod, Collins, Hoopes, Reck, and Sebastiani (2017). The authors find that after sole proprietorships are subject to a new information reporting requirement to the IRS, the businesses' increase in reported revenues are largely offset by an increase in reported expenses.

2.2 SETTING AND HYPOTHESIS DEVELOPMENT

I use the staggered adoption of EBT programs to capture a change in cash circulation in a particular region that is plausibly exogenous to consumer spending and income levels. The first test uses cross-year and cross-state variation of transfer payments across all states in the U.S. The second test uses cross-quarter and cross-county variation of transfer payments within Missouri.

EBT is an "electronic system that allows a recipient to authorize transfer of their government benefits from a Federal account to a retailer account to pay for products received."[17] EBT was established as an alternative government payment issuance platform as part of the Mickey Leland Memorial Domestic Hunger Relief Act of November 28, 1990 (P.L. 101-624). Pilot programs achieved the goal of improving benefit transfer efficiency. Consequently, the Conference Report for the Omnibus Budget Reconciliation Act of 1993 (P.L. 103-66) recommended the Secretary of Agriculture encourage state agencies to adopt EBT systems. EBT implementation at the state level began with Maryland in 1993 and concluded with California in 2004. It is now used in all 50 states, the District of Columbia, and several U.S. territories.

Several welfare programs are available through EBT. By far, the most common and economically significant are the Supplemental Nutrition Assistance Program (SNAP) (formerly referred to as food stamps) and the Temporary Assistance for Needy Families (TANF). SNAP is available through EBT in all 51 jurisdictions and TANF is available through EBT in 38 jurisdictions. Smaller state programs, such as Washington's "Aged,

[17] U.S. Department of Agriculture https://www.fns.usda.gov/snap/ebt

Blind, or Disabled" program, also sometimes are available through EBT.[18] Appendix A lists the programs available through each state's EBT program.[19]

Among the federal and state EBT programs, the transition of TANF to electronic transfer resulted in the most direct decrease in cash that jurisdictions experienced. Prior to EBT, TANF benefits were paid by paper checks. Recipients would cash their government checks and use cash as a primary means of transaction.[20] SNAP benefits were previously distributed as food stamps, a paper coupon-based transaction medium. While recipients had no legal means to convert their stamps to cash, they could illegally convert them to cash to purchase goods or services not permitted under the food stamp program (e.g. Pulliam 1997; Macaluso 2000; Schanzenbach 2007). EBT was implemented to help curtail this illegal conversion. Although no legal conversion mechanism existed and illegal conversion was relatively rare, it is likely the transition of SNAP to EBT contributed somewhat to decreased cash levels.

[18] "The Aged, Blind, or Disabled (ABD) program provides cash assistance to eligible low-income adults who are age 65 or older, blind, or determined likely to meet Supplemental Security Income (SSI) disability criteria based on a physical or mental impairment that is expected to last at least 12 consecutive months." https://www.dshs.wa.gov/esa/program-summary/aged-blind-or-disabled-abd-cash

[19] The programs available through EBT continue to change and expand. For example, Public Law 111-296 requires all states to implement the Special Supplemental Food Program for Women, Infants, and Children (WIC) through EBT no later than October 1, 2020. For WIC EBT activity see https://www.fns.usda.gov/wic/wic-ebt-activities.

[20] California's Post Implementation Evaluation Report on EBT supports the position that EBT caused a decrease to cash circulation. The report states that post-implementation "recipients no longer have to cash their entire warrant at one time and carry cash on their person or protect their food stamp coupons as if they were cash." It is important to note that recipients can withdraw cash from their TANF funds using a point-of-sale terminal during a purchase or by using an ATM. However, a transaction fee may be charged that varies by state and withdrawal method. Additionally, because it is business that are able to avoid taxes using cash, not the welfare recipients, individuals are not incentivized to withdraw and transact in cash. The frictions imposed by the transaction fee, the effort to withdraw cash, and the decreased security of cash, mean taxpayers are less likely to withdraw cash. This statement is consistent with my conversations with benefits administrators.

I use the adoption of EBT to identify a decrease in the level of cash circulation in a specific jurisdiction. I first use the staggered adoption of EBT across all U.S. states and the District of Columbia to examine the impact from a decrease in cash on reported taxable income. The national adoption occurred from 1993 to 2004. Appendix B lists the implementation dates of state EBT programs. The states' adoption pattern is not associated with geographical clustering or state economic connections. The change in cash circulation is plausibly exogenous to income levels and spending behavior because the goal of the EBT program was primarily to improve benefit transfer efficiency.[21]

Although Morse et al. (2009) document through interviews that cash transactions are less commonly reported, it is not clear that an EBT system will impact tax compliance. If EBT recipients choose to incur withdrawal fees (ATM or otherwise), they can continue to spend their benefits in cash. Thus, businesses would continue to receive cash payments and underreport report the cash income. It is also possible that businesses were reporting a portion of their cash transactions, and they could simply decrease the portion they report in response to an increase in more verifiable payment methods. Although these factors could explain that EBT adoption had no effect on reported income, they should not predict a negative association. Thus, I state my first hypothesis in the alternative form.

[21] It is possible that receiving an EBT card in lieu of cash alters a recipient's spending preferences. However, in their study on the effect of SNAP on the marginal propensity to consume food, Hastings and Shapiro (2018) note that "nationally representative survey data, and data from the Nielsen Homescan Consumer Panel, show that SNAP participation is only weakly related to a household's choice of retailer." Anecdotal evidence with state benefit administrators also indicates that EBT implementation did not significantly affect spending behavior.

HYPOTHESIS 1a: *Reported taxable income increases after EBT implementation*

Next, I use Missouri's staggered EBT adoption to examine the impact from a decrease in cash on reported taxable sales. Missouri staggered the implementation of EBT adoption by county in eight core phases from June 1997 to May 1998. Examining reported taxable sales provides evidence that cash directly affects sales tax, which is a non-income-based tax, and contributes to income tax. Wright et al. (2017) use this setting to provide evidence that less cash leads to less street crime such as robbery and assault. Consistent with the first hypothesis, I state my second hypothesis in the alternate form.

HYPOTHESIS 1b: *Reported taxable sales increase after EBT implementation.*

Chapter 3: Data and Sample Selection

The test data come from various government agencies: IRS, Bureau of Economic Analysis (BEA), FDIC, U.S. Department of Health & Human Services' Office of Family Assistance, U.S. Department of Agriculture, U.S. Small Business Administration, and the Missouri Department of Revenue. My various analyses use data that span from 1990 to 2017, aggregated at either the county or MSA level.

The staggered national EBT adoption occurred over a period of 12 years; Maryland was the first state to adopt in 1993, and California was the last state to adopt in 2004. Figure 1 depicts the number of state adoptions of EBT programs by year. The largest number of states that adopted an EBT program in a single year was 14 in 1998. U.S. Department of Agriculture's EBT Status Report provide implementation dates. Components of taxable income measures from the IRS SOI for the years 1990 to 2007 offer sufficient data pre and post implementation, covering 18 years. See Table 1, Panel A for sample construction. The data include each available county for a total of 56,400 county-year observations. I then drop county-years missing information from the IRS and BEA to conduct my analyses. This leaves a total of 55,338 county-years, indicating my sample includes about 97.8 percent of U.S. counties.[22]

Missouri's staggered EBT adoption occurred from June 1997 to May 1998. Figure 2 depicts the counties of Missouri and their dates of EBT adoption. I collect taxable sales data, reported quarterly by the Missouri Department of Revenue, from January 1995 to

[22] This estimate is based off the U.S. Geological Survey report that there are a total of 3,142 counties in the United States.

December 2000. The data provide sufficient pre and post implementation periods for analysis. See Table 1, Panel B for sample construction. Data for all 115 counties provides a total of 2,760 county-quarter observations. Dropping the 24 county-quarters missing economic profile data from the BEA, provides a total sample of 2,736 county-quarters. The final sample covers 114 counties per quarter for a coverage of more than 99 percent of the counties in Missouri.

To provide magnitude estimates on the effect of cash on tax evasion, I collect the amount of money distributed through the SNAP and TANF programs from the U.S Department of Agriculture and the Office of Family Assistance. Appendix C lists the total average expenditures by state. Average annual (from 1997-1999) expenditures from SNAP and TANF are $17.4 billion and $21.4 billion, for a total of $38.7 billion distributed. As expected, states with the largest expenditures include California and New York, and states with the smallest include Idaho and Wyoming.

Chapter 4: Empirical Design and Results

4.1 Staggered EBT Implementation Nationally

I test hypothesis one, which predicts the impact of the staggered, national EBT implementation increases reported taxable income, using the following OLS pooled, cross-sectional regression:

$$GROSS\ INCOME_{cy} = \beta_0 + \beta_1 EBT_{cy} + \sum \beta_j CONTROLS_{cy} + \gamma_c + \delta_y + \varepsilon_{cy} \quad (1)$$

The outcome variable is the natural log of gross income reported in county *c* during year *y*. Unfortunately, the IRS does not report separately all components of gross income during the sample period for national EBT implementation. See Figure 3 for a timeline of sample periods and data availability. Ideally, I would prefer to test separately for the hypothesized effect on Schedule C Self-Employment income, with a falsification test of no-effect on wages, interest, and dividend income; however, that is not possible during the EBT sample period. My variable of interest (*EBT*) is an indicator equal to one for each full county-year after the EBT program was implemented. A significant coefficient on *EBT* indicates reported taxable income was impacted by the decrease to cash caused by the EBT program implementation. The magnitude of the coefficient measures the economic effect of the change in cash.

I include a series of control variables (*CONTROLS*) to control for different types of income that impact purchasing power and spending behavior. *WAGE* is the amount of wages and salaries (in thousands) divided by the population. *RETIREMENT* is the amount of retirement income (in thousands) transferred from businesses or governments, including retirement and disability insurance benefits, divided by the population.

DIVIDENDS AND INTEREST controls for personal income from dividends, interest, and rental properties (in thousands) divided by the population. *SUPPLEMENTAL* is income from employer contributions to government social insurance and pension plans (in thousands) divided by the population. *TRANSFER RECEIPTS* represent income for which no current services are performed, such as unemployment insurance benefits and gifts (in thousands), divided by population.

Overall, I expect all these income numbers (per person) to be positively associated with taxable income. However, retirees and high-wealth individuals spend a much lower proportion of income on taxable purchases, so I expect *RETIREMENT* and *DIVIDENDS AND INTEREST* to contribute less to taxable income.

I also include *EMPLOYMENT* to control for the employment rate, defined as the total number of jobs divided by the population. *EMPLOYMENT* rate should be positively associated with taxable sales per person because people spend more when the local economy is doing well. Finally, I include *POPULATION* to control for the total population (in thousands) of all civilian and military persons in a county. I expect *POPULATION* to be positively associated because prosperous economies attract businesses and people. I also include county and year fixed effects.

The national implementation occurred between 1993 and 2004, spanning the 1997-1998 period of the Missouri implementation. I inflation adjust all per-capita dollar amounts to the midpoint year 1998, using the Consumer Price Index Inflation Calculator from the Bureau of Labor Statistics. This allows a comparison of real dollars across my sample period.

Table 2, Panel A details the summary statistics. The mean (median) of *GROSS INCOME* is 12.73 (12.57), which represents $13,046 ($12,278) per person per year, where person is the entire population, including non-working children and retirees. Wage income is the largest income source with an average (median) annual of $9,162 ($8,039) per person. The employment rate is near 51 percent. The mean county population is 88,500 with a median of 24,289, indicating population levels vary significantly. However, income data are not markedly skewed between counties.

Table 3, Panel A displays Pearson and Spearman correlations. As expected, *GROSS INCOME* is generally positively correlated with the different types of income, including *WAGE* and *DIVIDENDS AND INTEREST*. Two of the income variables are negatively associated, providing preliminary evidence that different types of income have a differential impact on spending behavior and taxable income.

Table 4 details the results of the first hypothesis. Column 1 includes the full set of control variables as well as county and year fixed effects. The coefficient on *EBT* of 0.005 is positive and significant (*p-value* < 0.1). This estimate indicates that reported taxable income did increase, on average, after the national EBT implementation by about half of one percent. Compared to the pre-period average of $16,044 per person per year, the increase equates to an increase of approximately $80.22 per person per year.

To provide magnitude estimates on the effect of a decrease to cash on taxable income, I use the amount of money distributed through the EBT program. Nationally, average SNAP expenditures are $17.35 billion and TANF expenditures are $21.39 billion, annually. However, not all states make TANF payments available through their

EBT programs. Therefore, estimates on the decrease to cash range from $19.1 billion, which includes only states where TANF payments are available through EBT, to $38.7 billion, which includes all states' SNAP and TANF payments. As I discussed in Section 2, shifting TANF payments to EBT caused a direct decrease in cash circulation, therefore, I assume transitioning TANF payments to EBT caused a dollar-for-dollar decrease to cash.[23] However, it is less clear how much SNAP's transition to EBT decreased cash because there is no legal mechanism for conversion from SNAP to cash pre-EBT. Therefore, I develop a range of estimates based on different assumptions about the effect on cash of SNAP's transition to EBT. I assume the SNAP changes could range from no effect to a dollar-for-dollar decrease.

Using these amounts, I calculate that, on average, by changing one dollar of cash payment to one dollar of digital payment, reported taxable income increases between $0.56 and $1.15. This range indicates that because a cash note is spent up to 50 times throughout the year, it can be underreported in multiple instances. Therefore, replacing cash with digital currency can increase the taxable income range by more than one dollar per replaced dollar.

Column 2 tests whether the effect on reported taxable income is less pronounced in areas less likely to be affected by the EBT implementation. I interact EBT with WAGE to examine the effect of the EBT transition in wealthier counties. Again, I find the coefficient on EBT* WAGE is negative with a value of -0.005 (p-value < 0.01),

[23] I make this assumption to provide a conservative estimate. If the decrease to cash circulation is less than the full amount of TANF benefits distributed, the estimated impact of cash on tax compliance would be greater.

indicating the effect is less pronounced in high-wage areas that are less likely to receive government welfare payments. In total, the evidence supports the hypothesis that a decrease in cash circulation caused an increase in reported taxable income.

4.2 STAGGERED EBT IMPLEMENTATION WITHIN MISSOURI

I test hypothesis two, examining the impact of the Missouri's staggered EBT implementation on reported taxable sales, using the following OLS pooled, cross-sectional regression:

$$TAXABLE\ SALES_{cq} = \beta_0 + \beta_1 EBT_{cq} + \sum \beta_j CONTROLS_{cq} + \gamma_c + \delta_y + \varepsilon_{cq} \quad (2)$$

The outcome variable is the natural log of taxable sales reported in county *c* during quarter *q*. My variable of interest (*EBT*) is an indicator equal to one for county-quarters ending after the implementation of the EBT program. H1b predicts *EBT* will be positively associated with *TAXABLE SALES*. A significant coefficient on *EBT* indicates reported taxable sales increased because of the decrease in cash caused by EBT implementation. The magnitude of the coefficient estimates the economic impact of the change in cash.

Missouri's EBT program implementation occurred within a 12-month time period, which should lessen concerns that results are affected by correlated-omitted variables such as changing economic circumstances that may have occurred over a longer period of time. To further control for the economic traits of a county that could impact reported taxable sales, I include the full set of control variables (*CONTROLS*) and county and year fixed effects from Equation 1.

Table 2, Panel B details my summary statistics. The Missouri summary statistics are comparable to those of the national sample. The mean (median) of *TAXABLE SALES* is 17.21 (17.01), which represents $1,560 ($1,346) per person per quarter. Again, wage income represents the largest income source with an annual average of $7,420 per person. The average Missouri county population during my sample period is 48,067, but the

median is 18,057, indicating population varies significantly between counties. The employment rate, including all persons, is about 51 percent, which is in line with the national average.

Table 3, Panel B displays Pearson and Spearman correlations. Correlations are consistent with those from the national sample in Panel A.

Table 5 shows the results of the second hypothesis. Column 1 includes the full set of control variables with county and year fixed effects. The coefficient on *EBT* of 0.079 is positive and significant (*p-value* < 0.01). This indicates that after EBT implementation reduced cash, reported taxable sales increased by about eight percent compared to the pre-period average of $1,472 per person per quarter. This equated to about a $116.30 increase per person per quarter. In the aggregate, this increase in taxable sales is $637.32 million per quarter at the state level. Based on the current state sales tax rate of 4.225 percent, Missouri's EBT implementation increased state sales tax revenue by $27 million per quarter.

I again develop my range of magnitude estimates from the SNAP and TANF expenditures transferred to the EBT program. In Missouri, average SNAP expenditures are $364 million and TANF expenditures are $300 million, annually. I compare these dollar amounts to the total increase in reported taxable sales to determine the impact of a decrease to cash circulation on tax compliance. I estimate a direct decrease to cash circulation ranging from $301 to $666 million per year after EBT implementation. Using this range of estimates, I calculate that transitioning a dollar of cash payment to a dollar of digital payment, increases reported taxable sales between $3.83 and $8.48.

In Column 2, I test whether the effect on reported taxable sales are less pronounced in areas less likely to be affected by EBT implementation. Counties with higher income levels per capita are less likely to receive government welfare payments and might be less affected by the switch from cash payments. To test this, I interact *EBT* with *WAGE* to examine the effect of the EBT transition in wealthier counties. I find the coefficient on *EBT* WAGE* of -0.003 is negative and significant (*p-value* < 0.1), indicating the effect is less pronounced in high-wage areas that are less likely to receive government welfare payments. This evidence is consistent with the decrease in cash circulation affecting the observed increase in reported taxable income.

Chapter 5: Additional Analysis

5.1 Pre-Treatment Trends

In this section, I provide evidence of pre-treatment trends. For my identification strategy, I presume the control samples (county-years that have not adopted EBT) are an appropriate counterfactual to the treated groups (county-years that have adopted EBT). The presumption does not require the level of taxable income to be equal between treatment and control counties prior to EBT implementation, but rather, that taxable income would have followed the same trend except for EBT implementation. If the two groups have deviating pre-treatment trends, it is difficult to determine how the trends might have continued without treatment. "Pre-treatment trends can also influence why some jurisdictions adopted rules, while others did not" (Atanasov and Black 2016) – an important element in this setting as states elected when to implement EBT.

To assess the validity of the identification strategy, I plot coefficients to analyze the trends in my outcome variables prior to and after EBT implementation. To evaluate pre-treatment trends, I replace the treatment indicator for EBT implementation with a series of county-specific variables to allow the outcome variables to vary with time. Each county's adoption date is designated as time zero. I then evaluate the outcome variables relative to the adoption date and estimate the average treatment effects following the regression framework from the main analyses. Coefficients of the regression are plotted along with ninety-five-percent confidence intervals.

Figure 4 depicts the pre-treatment trends for taxable income. The results provided are consistent with reported taxable income increasing after EBT adoption. After EBT

adoption, treated counties show increased taxable income relative to control counties. The increase in reported taxable income begins after adoption and becomes statistically significant in the post periods. The overall pattern supports the assumption that non-adopting counties are a suitable control group and the change in cash circulation affected tax compliance.

5.2 FALSIFICATION USING ALTERNATIVE MEASURES OF INCOME

Next, I test whether alternative economic factors other than EBT implementation could have increased reported taxable sales and income. As stated earlier, during EBT implementation, I am unable to measure directly the income of small businesses. Therefore, it is possible other income sources drive the observed increase in reported taxable income post EBT implementation. To address this concern, I re-estimate Equations 1 and 2 but replace the dependent variable with *WAGE*, *EMPLOYMENT*, and *DIVIDENDS AND INTEREST*. A finding that these other income sources are not significantly higher in the post period supports the theory that the observed increase in reported income is concentrated among small businesses.

Table 6, Panel A presents the results for the national sample. Across the three specifications, I find no evidence to indicate that other sources of income are significantly higher in the post period. As expected, there are no significant results for *WAGE* or *EMPLOYMENT*. Interestingly, a significant but negative coefficient exists on *DIVIDENDS AND INTEREST*. This might be the result of the increased tax compliance costs reducing taxpayers' ability to spend or invest money that had previously gone unreported to the government. Notably, however, none of these other types of income affects the increase in reported taxable income reported in Table 4. These results suggest the change in cash circulation from EBT implementation caused the increase in reported taxable income.

Table 6, Panel B presents the Missouri sample results. The findings are generally consistent with the national sample and do not indicate significant results for *WAGE* or

EMPLOYMENT. A significant but negative coefficient on *DIVIDENDS AND INTEREST* does exist. As with the previous sample, there is no evidence to indicate that the increase in taxable sales reported in Table 5 is driven by these other types of income. Overall, these tests support the theory that a decrease to cash circulation increases the tax compliance of small businesses.

5.3 CAPITAL ALLOCATION, EVIDENCE FROM SMALL BUSINESS LOANS

In this section, I examine the effect of cash circulation on capital allocation for small businesses. Because tax returns provide verifiable income information, banks generally rely on them to support loan applications (Morse et al. 2009).[24] However, if a small business does not report its cash income to the tax agency, it generally cannot use that income to support a bank loan. "Accordingly, a small business owner who fails to fully report income for tax purposes sacrifices the capacity of the unreported income to support bank financing and must make do with savings or other self-financing strategies" (Morse et al. 2009). Therefore, I posit the decrease to cash circulation caused by EBT implementation will lead to a corresponding increase in bank lending to small businesses. If so, increasing tax compliance generates a positive consequence to capital formation.

To test this conjecture, I use the U.S. Small Business Administration's 7(a) loan program as the setting. As stated by the SBA "the 7(a) loan program is the SBA's primary program for providing financial assistance to small businesses."[25] Only small businesses – generally fewer than 500 employees – qualify for SBA 7(a) loans. The business must operate for profit in the United States, and the owner must have invested equity in the form of time or capital.[26] Businesses must submit an SBA 7(a) application

[24] The fact that banks rely on tax returns to validate loan amounts is further supported by evidence that only about one third of private firms produce financial statements (Lisowsky and Minnis 2020) and that tax returns serve as substitutes for financial statements (Minnis and Sutherland 2017). Additionally, the National Survey of Small Business Finances conducted by the Federal Reserve Board indicates less than 20 percent of small businesses even use financial statements (Allee and Yohn 2009).

[25] https://www.sba.gov/partners/lenders/7a-loan-program/types-7a-loans#section-header-2

[26] Certain businesses are specifically excluded from qualifying, including real estate investment firms, firms involved in speculative activities, rare coin and stamp dealers, firms whose stock in trade is money, pyramid sales plans, firms involved in gambling activities, not-for-profit institutions, and firms involved in illegal activities.

along with supporting documents such as a personal background statement, projected financials, business license, business lease, and income tax returns for the previous three years. Applicants must obtain IRS income tax return transcripts prior to SBA loan submission. Transcripts are obtained by submitting form 4506-T, which eliminates the possibility that taxpayers could submit different returns to the government and to the lender. SBA loans have more lenient approval criteria than conventional loans, but still hinge on the business's financial integrity.

The terms, rates, and amounts of SBA loans vary based on the applicant's needs and qualifications. The current Standard 7(a) loan has a maximum amount of $5 million and a maximum maturity of ten to twenty-five years, depending on the business type. The interest rate paid is equal to a base rate plus between two and six percent.[27] Different types of 7(a) loans can impact the terms and turnaround time, but the Standard 7(a) loan is the most common.

I obtain data on SBA 7(a) loans from Freedom of Information Act information hosted by the U.S. Small Business Administration. The data include information on 7(a) loans spanning the full national EBT implementation period from 1990-2007. Data include the total loan amount, the amount of the loan charged off, and the address of the borrower. I use the borrower address to aggregate the loan data at the county level using the Centers for Disease Control and Prevention County Cross Reference File. In total, the

[27] The base rate "may be pegged to the lowest prime rate, the LIBOR Rate, or the SBA optional peg rate. The optional peg rate is a weighted average of rates the federal government pays for loans with maturities similar to the average SBA loan." https://www.sba.gov/partners/lenders/7a-loan-program/terms-conditions-eligibility#section-header-5

sample includes 833,813 individual small business loans with a mean (median) loan and charge off amount of $201,215 ($153,000) and $16,038 ($715).

To test the impact of EBT implementation on small business lending, I re-estimate Equation 1 and replace the outcome variable with three measures of loans to small businesses. The first measure is *LOAN AMOUNT*, which is the total SBA 7(a) loan amount divided by the number of loans issued per county. Second, *LOAN CHARGEOFF* is the total balance charged off from a loan divided by the number of loans issued per county. Third, *LOAN COUNT* is the number of loans issued by county.

Table 7 presents the results for small business lending. In Column 1 the coefficient on *LOAN AMOUNT* is positive and significant (*p-value* < 0.01). The coefficient of 12,224.79 indicates that after EBT implementation, SBA loan amounts increased by $12,224.79 or by about six percent compared to the pre-period average. This result supports the position that SBA loan applicants were able to support higher loan amounts by reporting more income on their tax return, and the decrease to cash circulation caused the change in reporting.

Table 7, Column 2 finds the coefficient on *LOAN CHARGEOFF* is positive but not significant at conventional levels. The positive coefficient indicates EBT did not improve loan quality. This finding is unsurprising because, even though applicants likely report higher income on their tax returns after EBT implementation, they do not necessarily have a greater ability to repay a loan in terms of cash flow. In fact, applicants would most likely experience a weaker ability to repay a loan because of the increased tax outflows from reporting the income. Column 3 does not indicate a significant

coefficient on *LOAN COUNT*. This result is expected as a tax reporting change is unlikely to significantly impact the number of small businesses seeking SBA loans. Taken together, the results indicate that increased tax compliance led to an increase in the amount of SBA loans but did not significantly impact the quality or number of loans issued.

5.4 FALSIFICATION USING RANDOMIZED TREATMENT ITERATIONS

I next perform a falsification test to address concerns that the increases in taxable sales and taxable income were not caused by the EBT implementation. An alternate explanation is that significant results could be found in various assignments of the pre and post indicators on each observation and I am incorrectly attributing the results to the EBT programs. To perform this test I randomly assign pre and post period indicators to observations in both the within-Missouri and national settings. I then re-estimate the baseline regressions with all of the same parameters from the original analysis. I repeat this analysis over 1,000 total iterations and measure the percentage of estimates that are significant.

Table 8, Panel A reports the results from the randomized falsification analysis for the national sample. Consistent with the falsification test above, the baseline regression for this analysis is Table 4, Column 1. In this analysis, 94 percent of the iterations are not significant at the same level as the baseline regression, consistent with the EBT implementation, causing the higher levels of reported taxable income.

Table 8, Panel B reports the results from the randomized falsification analysis for the within-Missouri sample. The baseline comparison regression for this analysis is Table 5, Column 1. Consistent with a reduction in cash causing an increase in reported taxable sales, I do not find statistically significant results at the standard levels of significance for the expected percent of iterations. Specifically, 99 percent of the iterations are not significant at the same level as the baseline regression. Overall, the results support the

conclusion that the EBT system reduced cash, causing an increase in reported taxable sales.

5.5 Federal Deposit Insurance Corporation Underbanked Survey

Finally, I use the FDIC National Survey of Unbanked and Underbanked Households as a third measure of cash circulation. The FDIC first conducted the household survey in 2009 and continues to do so on a biennial basis. The most recent data available are for 2017. Because the survey occurred in a later period than EBT implementation, it is possible to directly capture small business income from sole proprietorships and test the association (see Figure 3). The data are available at the state level and for 273 MSAs, which provides needed variation in the analyses. The survey includes a series of questions to determine an individual's banking status. It also includes information about why individuals are underbanked as well as general demographics such as age and education levels.

The survey indicates that "18.7 percent of U.S. households were "underbanked" in 2017, meaning the household had an account at an insured institution but also obtained financial products or services outside the banking system. Specifically, a household is categorized as underbanked if it had a checking or savings account and used one of the following products or services from an alternative financial services (AFS) provider in the past 12 months: money orders, check cashing, international remittances, payday loans, refund anticipation loans, rent-to-own services, pawn shop loans, or auto title loans." (Underbanked Executive Summary 2017).

Underbanked households are more likely to rely on cash as a means of exchange relative to other transaction methods. According to the FDIC survey, 26.2 percent of underbanked households pay bills with cash, and 41.3 percent receive income in the form

of a paper check or cash. I use the underbanked rate to proxy for the relative cash circulation within an MSA. I use underbanked households instead of unbanked because I am better able to capture the effect of cash spending on reported income for two reasons. First, the percentage of underbanked households is significantly larger than unbanked households (18.7 percent compared to 6.5 percent). Second, compared to unbanked households, underbanked households have significantly higher levels of income with approximately 55.8 percent above $30,000. I predict the percentage of underbanked households is associated with lower reported income from sole proprietorships.

I collect data on the number of underbanked households from the FDIC National Survey of Unbanked and Underbanked Households. Table 1, Panel C reports the sample construction for the underbanked sample. I collect income measures from the SOI at the county level and match to the FDIC survey at the MSA level using the National Bureau of Economic Research CBSA (Core-Based Statistical Area) to FIPS (Federal Information Processing Standards) County Crosswalk linking table for a total sample of 1,060 MSA-year observations.[28] Starting in 2010, the SOI began reporting components of gross income, which permit more powerful tests of the theory. Thus, the underbanked sample begins with the 2011 biennial survey and ends in 2017, the most recent year for which both the FDIC survey and SOI data are available. I remove observations missing sufficient data from the FDIC for a final sample of 1,032 MSA-years.[29]

[28] The linking table is available at https://www.nber.org/data/cbsa-fips-county-crosswalk.html

[29] In 2017, the total number of returns that reported business or professional net income or loss was 25,952,780 with a total net income of $348 billion reported. My sample has an average of 77,718 returns reporting income per MSA-year. With 258 MSAs included in my sample per year, I cover an average of 20,051,244 returns per year. This indicates my sample covers about 77 percent of the returns filed.

I test my expectation by examining the association between under-banking and reported small business income using the following OLS pooled, cross-sectional regression:

$$REPORTED\ INCOME_{my} = \beta_0 + \beta_1 UNDERBANKED_{my} + \sum \beta_j CONTROLS_{my} + \gamma_s + \delta_y + \varepsilon_{my} \quad (3)$$

The outcome variable is one of four measures of income reported on an individual tax return. The IRS began separately reporting income types in 2010, so I can capture different income measures.[30] *BUSINESS INCOME* is the business income reported on Schedule C (in thousands) on an individual tax return (Form 1040) divided by the number of returns filed that reported business income by MSA. *BUSINESS INCOME* is less verifiable than other forms of income and, therefore, more likely to be associated with cash circulation. The other three measures of income are all more verifiable and, therefore, less likely to be affected by cash. *SALARY AND WAGE* is the salary and wage income amount reported (in thousands) divided by the number of returns reporting wage income. *INTEREST* is the amount of interest income reported (in thousands) divided by the number of returns reporting interest income. *DIVIDENDS* are ordinary dividends reported (in thousands) divided by the number of returns reporting dividends.

My variable of interest is *UNDERBANKED*, which captures a population that is more likely to rely on cash as a means of transaction. *UNDERBANKED* is measured as the percentage of FDIC survey respondents identified as underbanked by MSA per year.

[30] The FDIC first administered the underbanked survey in 2009. However, due to the IRS reporting change in 2010, I begin my sample period in 2011 and conclude with the most recent survey data in 2017.

A significant coefficient on *UNDERBANKED* indicates the taxable income reported by small businesses is associated with the cash.

I control for other factors available in the FDIC survey data that can affect reported incomes. I control for the average age of survey respondents (*AGE*) because earnings potential fluctuates with age. *AGE* is the average age group of survey respondents within an MSA measured in ten-year increments from 15 to 64 and then as 65 years or greater. *EMPLOYMENT RATE* captures the percentage of survey respondents identified as employed because employment status directly affects income. *EDUCATION* controls for education level, which is categorized in four groups: no high school diploma, high school diploma, some college, and college degree. Finally, Gross Domestic Product (GDP) of a state is included and measured in billions of dollars, to control for overall economic activity within a state.

Table 2, Panel C details summary statistics. The average percentage of underbanked households in an MSA is about 10 percent. Salary and wage income represent the largest source of income with the average of $49,502 per reporting tax return. Business income is, on average, $12,355 per reporting tax return. The average age group is from 45 to 54 years old, and the average respondent received a high school diploma. The employment rate is similar to the two EBT settings at 57 percent.

Table 3, Panel C displays the correlation table. *BUSINESS INCOME* is generally positively correlated with the different types of income as well as *AGE GROUP, EMPLOYMENT RATE, EDUCATION,* and *STATE GDP.* Additionally, it is negatively

correlated with *UNDERBANKED*, which provides preliminary evidence in support my expectation.

Table 9 reports the results. In Column 1, I test the association with reported *BUSINESS INCOME* and find the coefficient on *UNDERBANKED* of -2.827 is negative and significant (*p-value* < 0.05). This indicates that areas more likely to rely on cash have lower reported levels of income from small businesses. Specifically, a one standard deviation increase in *UNDERBANKED* is associated with a decrease of $149.83 reported income per business.

In Columns 2 through 4 the dependent variables are *SALARY AND WAGE*, *INTEREST*, and *DIVIDENDS*. Consistent with expectations, I do not find significant results for any of the more verifiable types of income. These results suggest the higher business income is not being driven by other economic factors. Overall, the evidence is consistent with higher levels of cash circulation being associated with lower levels of reported business income.

Chapter 6: Conclusion

Cash plays a significant role in tax compliance. Because of the difficulty in verifying cash-based transactions, public policy experts speculate that cash is used to underreport income to tax authorities. However, due to the concealment activities of tax evaders, studying and quantifying the impact of cash on tax evasion remains a difficult problem. Using several measures of cash circulation, I provide new evidence on the impact of cash on tax compliance.

I capture a reduction to cash circulation plausibly exogenous to true income and spending habits using the implementation of the EBT program. I find that when government replaces cash payments with digital payments, reported taxable income and reported taxable sales both increase. Specifically, I find that, per replaced dollar, reported taxable income increases between $0.56 and $1.15 and reported taxable sales increase between $3.83 and $8.48. Importantly, the results are not driven by an increase to other types of income.

Additionally, using the data on small business loans from the SBA, I examine the impact of reduced cash circulation on capital allocation. I find that small business loan amounts increased after EBT implementation by about six percent. The result is consistent with small businesses reporting increased income on their tax returns after EBT implementation and, thus, improving tax compliance and capital allocation.

The results remain robust to a number of additional tests and falsification checks. Parallel trends do not reveal differences in pre-treatment trends, and the results do not appear to be driven by increases to other types of income, such as wages, dividends, or

interest. Additionally, as expected, I do not find significant results using randomized placebo implementation periods.

Finally, I use the FDIC National Survey of Underbanked Households data to confirm the effect is concentrated among small businesses, which are most likely to experience a change to cash circulation. This analysis is possible because IRS income data are more granular in the recent FDIC survey period. Evidence is consistent with my main analyses. Small businesses use cash as a method to evade an economically significant amount of tax.

Overall, my results support public policy experts' claim that a decrease to cash circulation can increase tax compliance. Policies to reduce cash include removing high denomination bills from circulation (Sands 2016), phasing out cash altogether (Rogoff 2017), or taxing cash withdrawals (Benshalom 2012). These plans would effectively reduce cash circulation, however, each has practical limitations and may negatively impact low-income communities that disproportionately rely on cash.

My paper provides direct evidence on the degree to which cash impacts tax evasion and demonstrates cash-based tax evasion can be reduced without regulating cash directly. Instead, governments can incentivize non-cash transactions, which are both more verifiable and secure than cash. Practicably, policy makers can improve access to mobile banking (Apaam et al. 2018), subsidize electronic point of sale systems for small businesses, provide accessible, low-cost bank accounts, or continue to transition state, cash-based welfare programs to EBT systems. Such proposals are likely to improve tax compliance while limiting the negative complications of limiting access to cash. My findings can help

policy makers as they evaluate systems that can equitably reduce cash circulation and help improve tax compliance.

Table 1: Sample construction

Panel A: EBT Implementation, United States – for tests of Hypothesis 1a	
Total county-years available from IRS	56,400
Less: missing tax return data	(40)
Less: missing economic data from BEA	(1,022)
County-years used for estimation	55,338

Panel A: Sample consists of 55,338 county-year observations from 1990-2007 with sufficient data from SOI and BEA for estimation. My sample contains an average of 3,074 counties per year. There are 3,142 counties in the United States according to the United States Geological Survey.

Panel B: EBT Implementation, Missouri – for tests of Hypothesis 1b	
Total county-quarters available from the Missouri Department of Revenue	2,760
Less: missing income data from BEA	(24)
County-years used for estimation	2,736

Panel B: Sample consists of 2,736 county-quarter observations within the state of Missouri from 1995-2000 with sufficient data from the Missouri Department of Revenue and BEA for estimation. My sample contains an average of 114 counties per quarter. There are a total of 115 counties in the state of Missouri.

Panel C: Underbanked Sample – Additional analysis	
Total MSA-years included in the FDIC survey	1,060
Less: missing underbanked data	(28)
MSA-years used for estimation	1,032

Panel C: Sample consists of 1,032 MSA-year observations from 2011, 2013, 2015, and 2017, years in which the FDIC National Survey of Unbanked and Underbanked Households was conducted. The United States Office of Management and Budget lists a total of 384 MSAs in the United States and the FDIC survey data materials list a total of 301 MSAs.

Table 2: Summary statistics

Panel A: EBT Implementation, National

	Mean	St. dev.	P25	Median	P75
GROSS INCOME	12.731	1.586	11.654	12.566	13.632
WAGE	9.162	6.116	5.885	8.039	10.858
DIVIDENDS AND INTEREST	4.183	2.023	3.013	3.873	4.895
RETIREMENT	3.469	0.908	2.843	3.399	4.026
SUPPLEMENTAL	2.287	1.453	1.510	2.046	2.751
TRANSFER RECEIPTS	3.945	1.009	3.261	3.880	4.572
EMPLOYMENT	0.505	0.149	0.410	0.494	0.581
POPULATION	88.500	288.719	10.863	24.289	61.275
N	55,338				

Panel A: Sample consists of 55,338 county-year observations from 1990-2007 with sufficient data from SOI and BEA for estimation. Variable definitions and sources are included in Appendix D.

Table 2 continued

Panel B: EBT Implementation, Missouri

	Mean	St. dev.	P25	Median	P75
TAXABLE SALES	17.212	1.368	16.195	17.014	17.877
WAGE	7.420	4.177	4.605	6.320	8.940
DIVIDENDS AND INTEREST	3.843	1.022	3.109	3.860	4.355
RETIREMENT	3.605	0.719	3.100	3.601	4.115
SUPPLEMENTAL	1.821	0.890	1.212	1.585	2.200
TRANSFER RECEIPTS	4.012	0.819	3.456	4.008	4.583
EMPLOYMENT	0.507	0.112	0.429	0.494	0.577
POPULATION	48.067	119.625	10.316	18.057	34.394
N	2,736				

Panel B: Sample consists of 2,736 county-year observations within the state of Missouri from 1995-2000 with sufficient data from the Missouri Department of Revenue and BEA for estimation. Variable definitions and sources are included in Appendix D.

Table 2 continued

Panel C: Underbanked Sample (Additional analysis)

	Mean	St. dev.	P25	Median	P75
BUSINESS INCOME	12.355	3.573	10.036	11.831	14.026
UNDERBANKED	0.105	0.053	0.067	0.098	0.133
SALARY AND WAGE	49.502	10.360	43.385	47.746	53.317
INTEREST	1.854	1.014	1.318	1.612	2.080
DIVIDENDS	7.040	4.804	4.834	6.122	7.826
AGE GROUP	4.050	0.314	3.858	4.043	4.227
EMPLOYMENT RATE	0.569	0.090	0.518	0.577	0.626
EDUCATION	2.724	0.234	2.593	2.742	2.868
STATE GDP	664.511	664.389	221.897	432.718	772.477
N	1,032				

Panel C: Sample consists of 1,032 MSA-year observations from 2011, 2013, 2015, and 2017, years in which the FDIC National Survey of Unbanked and Underbanked Households was conducted. Variable definitions and sources are included in Appendix D.

Table 3: Correlation tables

Panel A: EBT Implementation, National

Variable		1	2	3	4	5	6	7	8
1	*GROSS INCOME*		0.44	0.20	-0.17	0.38	-0.16	0.15	0.53
2	*WAGE*	0.60		0.34	-0.11	0.93	-0.11	0.80	0.29
3	*DIVIDENDS AND INTEREST*	0.18	0.38		-0.05	0.27	-0.12	0.48	0.16
4	*RETIREMENT*	-0.19	-0.11	-0.06		-0.06	0.98	-0.05	-0.07
5	*SUPPLEMENTAL*	0.56	0.96	0.35	-0.03		-0.06	0.76	0.23
6	*TRANSFER RECEIPTS*	-0.19	-0.13	-0.16	0.98	-0.05		-0.11	-0.05
7	*EMPLOYMENT*	0.16	0.72	0.62	-0.02	0.69	-0.09		0.13
8	*POPULATION*	0.98	0.55	0.08	-0.19	0.51	-0.16	0.09	

Panel A: This table presents correlations for all variables used in the main regression analysis. Sample consists of 55,338 county-year observations from 1990-2007 with sufficient data from SOI and BEA for estimation. Pearson (Spearman) correlations are presented above (below) the diagonal.

Table 3 continued

Panel B: EBT Implementation, Missouri

	Variable	1	2	3	4	5	6	7	8
1	*TAXABLE SALES*		0.77	0.35	-0.31	0.72	-0.29	0.47	0.68
2	*WAGE*	0.69		0.55	-0.08	0.98	-0.07	0.81	0.64
3	*DIVIDENDS AND INTEREST*	0.18	0.43		0.06	0.52	-0.03	0.61	0.48
4	*RETIREMENT*	-0.30	-0.04	0.10		-0.08	0.99	-0.02	-0.19
5	*SUPPLEMENTAL*	0.65	0.98	0.41	-0.04		-0.07	0.82	0.56
6	*TRANSFER RECEIPTS*	-0.29	-0.06	0.01	0.99	-0.05		-0.05	-0.18
7	*EMPLOYMENT*	0.35	0.78	0.60	0.03	0.78	-0.01		0.37
8	*POPULATION*	0.96	0.59	0.09	-0.39	0.55	-0.37	0.23	

Panel B: This table presents correlations for all variables used in the main regression analysis. Sample consists of 2,736 county-year observations within the state of Missouri from 1995-2000 with sufficient data from the Missouri Department of Revenue and BEA for estimation. Pearson (Spearman) correlations are presented above (below) the diagonal.

Table 3 continued

Panel C: Underbanked Sample (Additional analysis)

	Variable	1	2	3	4	5	6	7	8	9
1	*BUSINESS INCOME*		-0.23	0.65	0.27	0.24	0.11	0.09	0.27	0.29
2	*UNDERBANKED*	-0.22		-0.23	-0.02	-0.06	-0.27	0.09	-0.24	0.00
3	*SALARY AND WAGE*	0.54	-0.24		0.33	0.34	-0.05	0.29	0.47	0.10
4	*INTEREST*	0.08	0.05	0.13		0.60	-0.04	0.10	0.11	0.08
5	*DIVIDENDS*	0.27	-0.12	0.44	0.62		-0.04	0.13	0.13	0.11
6	*AGE GROUP*	0.10	-0.25	-0.07	-0.15	-0.04		-0.49	-0.12	-0.07
7	*EMPLOYMENT RATE*	0.12	0.08	0.38	0.12	0.15	-0.47		0.32	-0.05
8	*EDUCATION*	0.28	-0.20	0.53	0.12	0.24	-0.10	0.31		-0.11
9	*STATE GDP*	0.20	-0.06	0.01	0.03	0.17	0.02	-0.11	-0.12	

Panel C: This table presents correlations for all variables used in the main regression analysis. Sample consists of 1,032 MSA-year observations from 2011, 2013, 2015, and 2017, years in which the FDIC National Survey of Unbanked and Underbanked Households was conducted. Pearson (Spearman) correlations are presented above (below) the diagonal.

Table 4 Reported gross income after staggered national electronic benefit transfer implementation

	(1) GROSS INCOME	(2) GROSS INCOME
EBT	0.005*	0.054***
	(1.857)	(5.572)
*EBT*WAGE*		-0.005***
		(-5.362)
WAGE	0.003	0.013***
	(0.988)	(3.536)
DIVIDENDS AND INTEREST	0.027***	0.028***
	(2.911)	(2.998)
RETIREMENT	0.232***	0.214***
	(7.820)	(7.142)
SUPPLEMENTAL	-0.005	-0.012**
	(-0.821)	(-2.131)
TRANSFER RECEIPTS	-0.312***	-0.297***
	(-11.314)	(-10.582)
EMPLOYMENT	0.205***	0.072
	(3.217)	(1.164)
POPULATION	0.001***	0.001***
	(4.680)	(4.749)
Observations	55,338	55,338
Adjusted R-squared	0.995	0.996
County fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

This table presents the results of OLS estimates of Equation 1, which tests the impact of the national staggered EBT program implementation on reported taxable income. My sample consists of 55,338 county-year observations from 1990 to 2007 with sufficient data for estimation. See Appendix D for all variable definitions and sources. Robust standard errors are clustered at the county level. *, **, and *** indicate statistical significance at the two-tailed 10%, 5%, and 1% level.

Table 5 Reported taxable sales after staggered electronic benefit transfer implementation in Missouri

	(1) TAXABLE SALES	(2) TAXABLE SALES
EBT	0.079***	0.098***
	(9.988)	(7.581)
*EBT*WAGE*		-0.003*
		(-1.819)
WAGE	0.007	0.017
	(0.488)	(1.168)
DIVIDENDS AND INTEREST	0.006	0.006
	(0.270)	(0.306)
RETIREMENT	0.016	-0.020
	(0.121)	(-0.153)
SUPPLEMENTAL	-0.025	-0.023
	(-0.402)	(-0.379)
TRANSFER RECEIPTS	-0.053	-0.018
	(-0.404)	(-0.142)
EMPLOYMENT	0.183	0.123
	(1.285)	(0.845)
POPULATION	0.007***	0.007***
	(4.073)	(4.129)
Observations	2,736	2,736
Adjusted R-squared	0.994	0.994
County fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

This table presents the results of OLS estimates of Equation 2, which tests the impact of the staggered EBT program implementation within the state of Missouri on reported taxable sales. My sample consists of 2,736 county-quarter observations from January 1995 to December 2000 with sufficient data for estimation. See Appendix D for all variable definitions and sources. Robust standard errors are clustered at the county level. *, **, and *** indicate statistical significance at the two-tailed 10%, 5%, and 1% level.

Table 6 Falsification test for more verifiable types of income

Panel A: EBT Implementation, National

	(1) WAGE	(2) EMPLOYMENT	(3) DIVIDENDS AND INTEREST
EBT	0.001	-0.000	-0.038***
	(0.071)	(-0.193)	(-3.054)
Observations	55,338	55,338	55,338
Adjusted R-squared	0.981	0.977	0.442
Controls	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes

This table presents the results of OLS estimates of Equation 1 with the dependent variable replaced with WAGE, EMPLOYMENT, and DIVIDENDS AND INTEREST. My sample consists of 55,338 county-year observations from 1990 to 2007 with sufficient data for estimation. See Appendix D for all variable definitions and sources. Robust standard errors are clustered at the county level. *, **, and *** indicate statistical significance at the two-tailed 10%, 5%, and 1% level.

Panel B: EBT Implementation, Missouri

	(1) WAGE	(2) EMPLOYMENT	(3) DIVIDENDS AND INTEREST
EBT	0.024	-0.001	-0.023**
	(1.046)	(-1.134)	(-2.538)
Observations	2,736	2,736	2,736
Adjusted R-squared	0.996	0.978	0.985
Controls	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes

This table presents the results of OLS estimates of Equation 2 with the dependent variable replaced with WAGE, EMPLOYMENT, and DIVIDENDS AND INTEREST. My sample consists of 2,736 county-quarter observations from January 1995 to December 2000 with sufficient data for estimation. See Appendix D for all variable definitions and sources. Robust standard errors are clustered at the county level. *, **, and *** indicate statistical significance at the two-tailed 10%, 5%, and 1% level.

Table 7: Reported small business loans after staggered national electronic benefit transfer implementation

	(1) LOAN AMOUNT	(2) LOAN CHARGEOFF	(3) LOAN COUNT
EBT	12,224.79***	1,582.10	0.180
	(3.33)	(1.37)	(0.240)
WAGE	3,910.68***	-101.58	1.528
	(3.11)	(-0.26)	(0.700)
RETIREMENT	-4,130.83*	-129.77	3.161
	(-1.95)	(-0.50)	(1.584)
DIVIDENDS AND INTEREST	48,866.37**	3,105.24	16.136
	(2.43)	(0.58)	(1.144)
SUPPLEMENTAL	2,720.13	-36.72	12.776***
	(0.46)	(-0.02)	(2.710)
TRANSFER RECEIPTS	-51,474.63***	-7,850.43	-14.951
	(-2.71)	(-1.58)	(-1.575)
EMPLOYMENT	-89,658.72	19,577.56	-104.185*
	(-1.61)	(1.50)	(-1.939)
POPULATION	-97.50***	14.30**	0.938***
	(-2.70)	(2.21)	(3.333)
Observations	40,102	40,102	40,102
Adjusted R-squared	0.156	0.048	0.788
County fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes

This table presents the results of OLS estimates of small business loans after EBT implementation. My sample consists of 40,102 county-year observations from 833,813 loans from 1990 to 2007 with sufficient data for estimation. See Appendix D for all variable definitions and sources. Robust standard errors are clustered at the county level. *, **, and *** indicate statistical significance at the two-tailed 10%, 5%, and 1% level.

Table 8: Falsification tests using randomized iterations of pre/post treatment assignment

Panel A: Randomized iterations of EBT Implementation – National

Iterated equation	Iterations	Percent of iterations not significant at 10%	5%	1%	level of baseline comparison: 6.3% Table 4, Column 1
Equation 1: **[Hypothesis 1a]** Reported taxable income increases after EBT implementation	1,000	90.90%	95.50%	99.40%	94.20%

Panel A: This is a falsification test for the results presented in Table 4, Column 1 on the EBT Implementation nationally. I randomly assign pre and post periods to state-year observations and re-estimate Equation 1. I repeat this process for 1,000 iterations and measure the percentage of estimations that were significant at 10%, 5%, 1%, and baseline comparison level. My sample consists of 55,338 county-year observations from 1990-2007 with sufficient data for estimation

Panel B: Randomized iterations of EBT Implementation – Missouri

Iterated equation	Iterations	Percent of iterations not significant at 10%	5%	1%	level of baseline comparison: < 0.01% Table 5, Column 1
Equation 2: **[Hypothesis 1b]** Reported taxable sales increase after EBT implementation	1,000	90.10%	94.80%	98.30%	99.70%

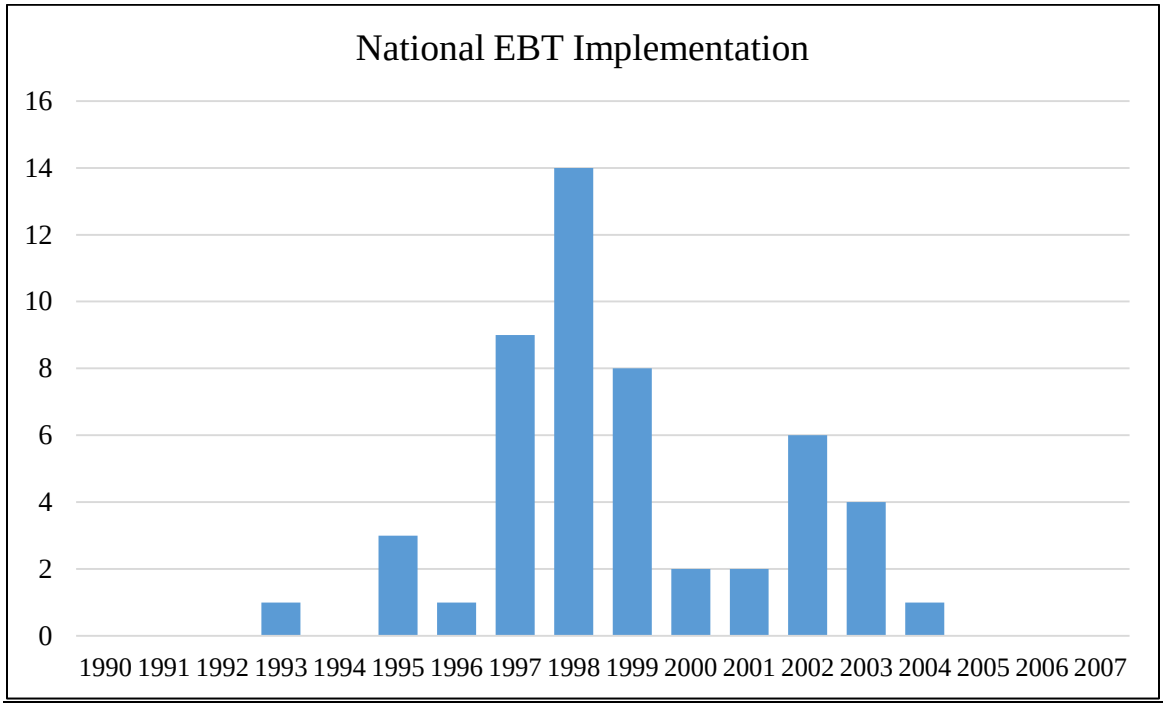
Panel A: This is a falsification test for the results presented in Table 5, Column 1 on the EBT Implementation within the state of Missouri. I randomly assign pre and post periods to county-quarter observations and re-estimate Equation 2. I repeat this process for 1,000 iterations and measure the percentage of estimations that were significant at 10%, 5%, 1%, and baseline comparison level. My sample consists of 2,736 county-quarter observations from January 1995 to December 2000 with sufficient data for estimation.

Table 9: The association between the underbanked and income types

	(1) BUSINESS INCOME	(2) SALARY AND WAGE	(3) INTEREST	(4) DIVIDENDS
UNDERBANKED	-2.827**	-1.055	-0.254	1.031
	(-2.195)	(-0.275)	(-0.544)	(0.574)
SALARY AND WAGE	0.139***		0.023***	0.024
	(14.681)		(3.527)	(1.356)
INTEREST	0.549***	2.130***		2.498***
	(3.341)	(4.595)		(11.853)
DIVIDENDS	0.055**	0.073*	0.084***	
	(2.203)	(1.879)	(3.315)	
AGE	0.772***	-1.598**	0.033	-0.050
	(3.501)	(-2.385)	(0.570)	(-0.206)
EMPLOYMENT RATE	0.527	7.923***	0.373	2.476**
	(0.717)	(3.163)	(1.363)	(2.200)
EDUCATION	1.561***	8.627***	-0.525***	-0.019
	(4.864)	(9.428)	(-5.169)	(-0.049)
STATE GDP	-0.002**	0.009**	-0.000**	0.001
	(-2.289)	(2.376)	(-2.087)	(1.253)
BUSINESS INCOME		1.633***	0.071***	0.211***
		(9.904)	(3.393)	(4.668)
Observations	1,032	1,032	1,032	1,032
Adjusted R-squared	0.777	0.688	0.644	0.528
State fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

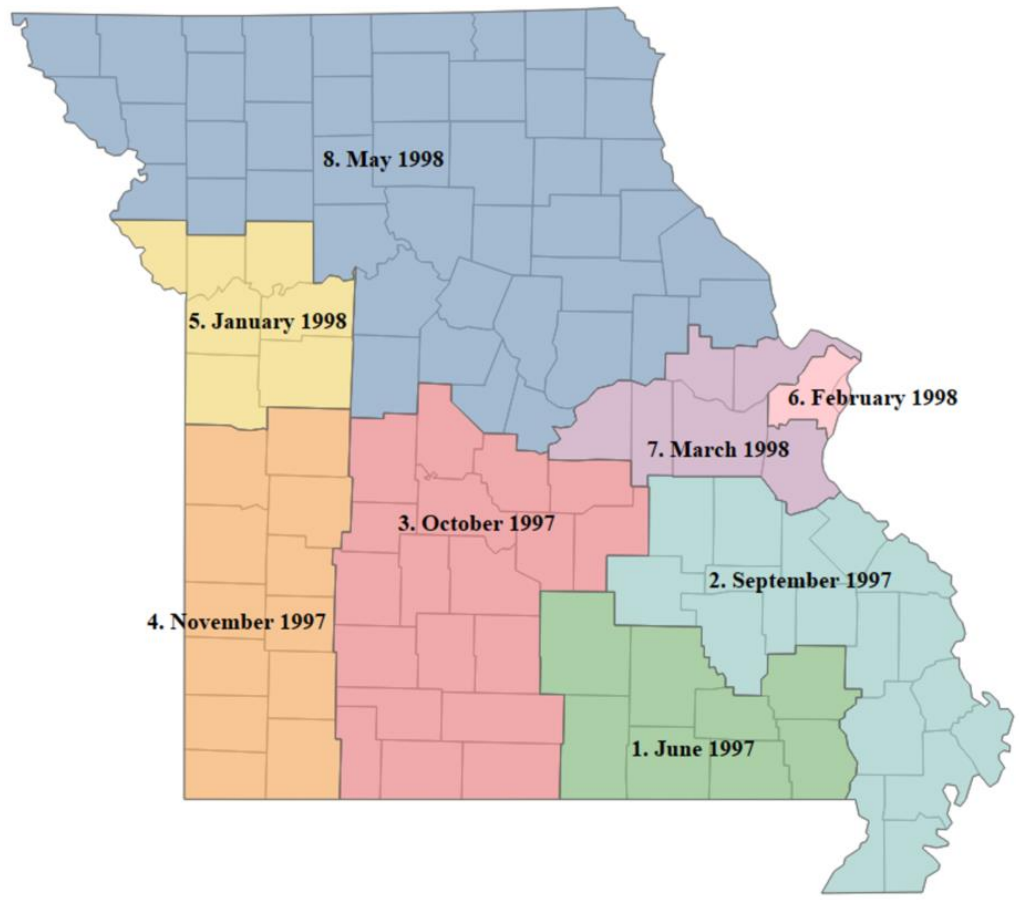
This table presents the results of OLS estimates of Equation 3, which tests the association between underbanked households and reported taxable incomes. My sample consists of 1,032 MSA-year observations from the years 2011, 2013, 2015, and 2017, years in which the underbanked survey data are available. See Appendix D for all variable definitions and sources. Robust standard errors are clustered at the MSA level. *, **, and *** indicate statistical significance at the two-tailed 10%, 5%, and 1% level.

Figure 1: National EBT implementation by number of states that implemented per year



My sample period covers the years 1990-2007. The graph depicts the number of states, including Washington D.C. that implemented an EBT program by year.

Figure 2: Missouri EBT implementation by county



EBT (Electronic Benefit Transfer) Implementation Dates

1. June 1997
2. September 1997
3. October 1997
4. November 1997
5. January 1998
6. February 1998
7. March 1998

Figure 3: Timeline of data availability and sample periods

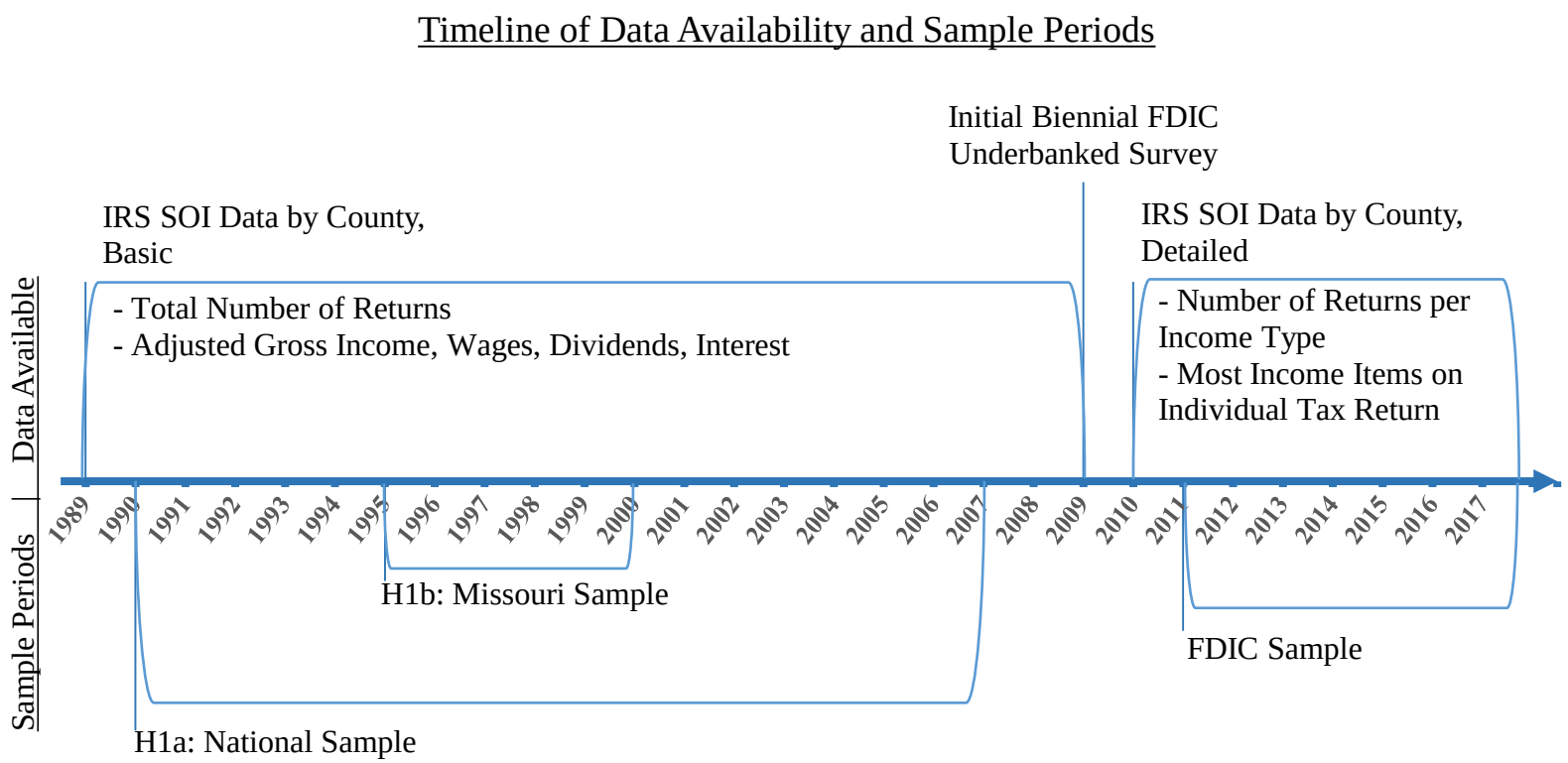
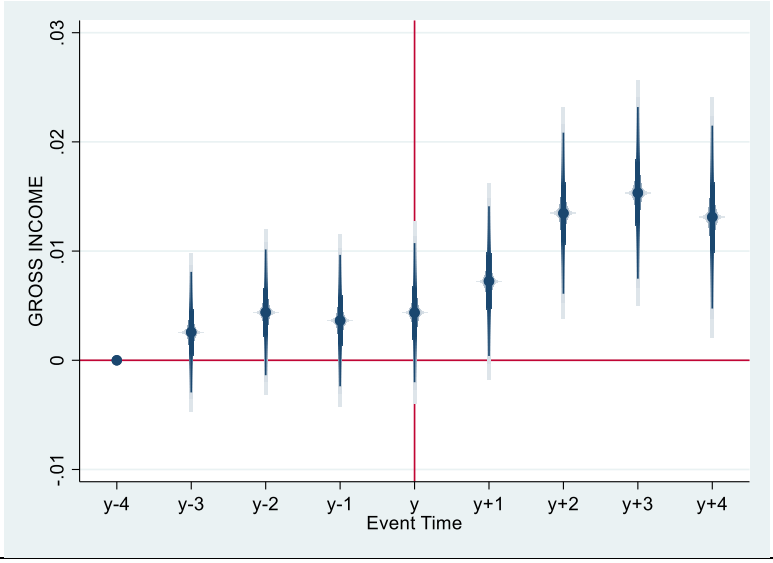


Figure 4: Pre-treatment trends



This figure reports the point estimates from a county-panel regression of GROSS INCOME on an indicator for EBT adoption, control variables, county, and year fixed effects. The specification allows the effect of EBT adoption to vary by year. Ninety-five-percent confidence intervals are also plotted.

Appendices

APPENDIX A: PROGRAMS AVAILABLE ON A STATE'S EBT SYSTEM

A detailed table of programs that are available through a state's EBT system

State	SNAP	TANF	Other Programs available
Alabama	Yes	Yes	
Alaska	Yes	Yes	
Arizona	Yes	Yes	TRE (Training Related Expenses)
Arkansas	Yes	Yes	
California	Yes	Yes	California Food Assistance Program (CFAP), Work Incentive Nutritional Supplement (WINS), General Assistance, Refugee Assistance, and State Utility Assistance Subsidy (SUAS)
Colorado	Yes	Yes	Child Care, Old Age Pension (OAP), Aid to the Needy Disabled (AND), Aid to the Blind (AB), Health Care Allowance (HCA), SSI-Colorado Supplement (SSI-CS), Low-Income Energy Assistance Program (LIEAP), Child Welfare and Subsidized Adoption
Connecticut	Yes	Yes	State Supplemental (Aid to Aged, Blind, Disabled), State Administered General Assistance (SAGA), Child Support Passthrough, Refugee, and LIHEAP
Delaware	Yes	No	
District of Columbia	Yes	Yes	Refuge Assistance, General Assistance for Children, and Disability
Florida	Yes	Yes	Refugee Cash and E&T support
Georgia	Yes	No	
Hawaii	Yes	Yes	TAONF (Temporary Assistance for Other Needy Families), General Assistance, AABD, Child Care subsidy, and First To Work support services
Idaho	Yes	Yes	
Illinois	Yes	Yes	State-Funded Food Assistance, Aid to the Aged Blind and Disabled (AABD), Refugee and Repatriation Assistance (RRA), TANF Supportive Services, WorkFirst, SNAP Employment and Training, Child Support Pass-Through, & Crisis Assistance
Indiana	Yes	Yes	
Iowa	Yes	No	
Kansas	Yes	Yes	Child Care

Kentucky	Yes	Yes	
Louisiana	Yes	Yes	
Maine	Yes	Yes	State Supplemental benefits
Maryland	Yes	Yes	
Massachusetts	Yes	Yes	Emergency Aid to the Elderly, Disabled and Children (EAEDC), Supplemental Nutrition Assistance (SNA)
Michigan	Yes	Yes	(Family Independence Program), SDA (State Disability Assistance) and LIHEAP (Low Income Home Energy Assistance Program).
Minnesota	Yes	Yes	Minnesota Family Investment Program (MFIP), Refugee Cash Assistance (RCA), General Assistance (GA), Minnesota Supplemental Aid (MSA), Diversionary Work Program (DWP) and Emergency Assistance (EA)
Mississippi	Yes	No	
Missouri	Yes	Yes	
Montana	Yes	Yes	TANF supportive services and Refugee cash
Nebraska	Yes	No	Child Care Time and Attendance
Nevada	Yes	Yes	
New Hampshire	Yes	Yes	Old Age, Aid to Needy, Blind and Disabled, State Funded Food Benefit, and Refugee Cash
New Jersey	Yes	Yes	General Assistance (GA) and e-Child Care
New Mexico	Yes	Yes	General Assistance (GA), Refugee Resettlement , Residential Shelter Care, and Support Services
New York	Yes	Yes	Medicaid, HBE, and HEAP
North Carolina	Yes	Yes	
North Dakota	Yes	No	
Ohio	Yes	No	
Oklahoma	Yes	No	
Oregon	Yes	Yes	Refugee Program, Prison Release Funds, Summer Electronic Benefit for Children, Low Income Heat and Eat Assistance Program and JOBS Participation Incentive
Pennsylvania	Yes	Yes	Cash, General Assistance, SSI, Medicaid
Rhode Island	Yes	Yes	
South Carolina	Yes	No	
South Dakota	Yes	No	
Tennessee	Yes	Yes	
Texas	Yes	Yes	TANF-State Program (TANF-SP)

Utah	Yes	Yes	General Assistance, Emergency Assistance, Refugee Assistance, Medical Transportation, Y and Z Funds, and SSI State Supplemental
Vermont	Yes	Yes	LIHEAP, Fuel benefits (“heat and eat”), cash benefits for renters and those that heat with wood.
Virginia	Yes	No	
Washington	Yes	Yes	State Financial Assistance, Aged Blind and Disabled (ABD), Refugee, Consolidated Emergency Assistance, LIHeap, SSP (State Portion)
West Virginia	Yes	Yes	Child Support
Wisconsin	Yes	No	
Wyoming	Yes	No	

The programs available through each state’s EBT program is available from the United States Department of Agriculture EBT Status Report

APPENDIX B: STATEWIDE EBT IMPLEMENTATION

A detailed table of the year in which a state's EBT program became operational statewide

State	Year of statewide implementation	State	Year of statewide implementation
Alabama	1997	Montana	2002
Alaska	1998	Nebraska	2002
Arizona	1999	Nevada	2002
Arkansas	1998	New Hampshire	1999
California	2004	New Jersey	1999
Colorado	1998	New Mexico	1995
Connecticut	1997	New York	2001
Delaware	2003	North Carolina	1999
District of Columbia	1998	North Dakota	1997
Florida	1998	Ohio	1999
Georgia	1998	Oklahoma	1998
Hawaii	1998	Oregon	1998
Idaho	1998	Pennsylvania	1997
Illinois	1997	Rhode Island	1998
Indiana	2002	South Carolina	1995
Iowa	2003	South Dakota	1997
Kansas	1997	Tennessee	1999
Kentucky	1999	Texas	1995
Louisiana	1997	Utah	1996
Maine	2003	Vermont	1998
Maryland	1993	Virginia	2002
Massachusetts	1997	Washington	1999
Michigan	2001	West Virginia	2003
Minnesota	1998	Wisconsin	2000
Mississippi	2002	Wyoming	2000
Missouri	1998		

The dates of statewide implementation of EBT transfers are available from the United States Department of Agriculture EBT Status Report

APPENDIX C: STATE SNAP AND TANF EXPENDITURES

Average SNAP and TANF expenditures per state across 1997-1999.

State	SNAP Expenditures	TANF Expenditures
Alabama	$ 365,530,150	$ 97,497,496
Alaska	50,286,352	72,257,778
Arizona	267,384,754	255,839,322
Arkansas	209,786,978	38,249,765
California	2,062,384,314	5,704,593,095
Colorado	161,221,059	134,025,557
Connecticut	160,243,986	435,051,107
Delaware*	35,765,654	50,376,626
District of Columbia	86,429,373	120,063,334
Florida	906,522,732	704,966,512
Georgia*	553,989,695	405,670,497
Hawaii	182,317,910	127,889,928
Idaho	48,446,736	20,501,664
Illinois	848,176,282	702,247,242
Indiana	270,524,709	233,952,033
Iowa*	112,562,212	158,587,819
Kansas	91,573,111	155,550,055
Kentucky	351,115,025	206,930,213
Louisiana	480,643,527	140,488,131
Maine	97,542,078	113,839,851
Maryland	279,510,665	302,133,952
Massachusetts	229,422,227	686,507,305
Michigan	593,647,140	1,035,648,303
Minnesota	181,678,437	280,601,144
Mississippi*	266,445,271	63,987,779
Missouri	364,769,826	300,738,815
Montana	53,395,322	40,641,572
Nebraska*	68,620,874	83,064,423
Nevada	64,401,018	61,127,712
New Hampshire	32,059,672	67,157,941
New Jersey	392,683,893	490,805,220
New Mexico	152,212,960	125,420,819
New York	1,582,693,316	3,371,482,910
North Carolina	444,662,100	371,941,552
North Dakota*	26,644,051	24,800,408
Ohio*	631,282,547	826,229,208
Oklahoma*	235,953,437	146,988,870

Oregon	201,310,661	289,430,236
Pennsylvania	777,735,505	687,996,404
Rhode Island	62,577,657	131,606,703
South Carolina*	265,253,796	69,974,489
South Dakota*	37,481,516	22,243,083
Tennessee	445,509,172	200,867,990
Texas	1,481,638,731	588,569,868
Utah	75,582,450	94,363,736
Vermont	36,047,158	63,284,292
Virginia*	322,840,887	156,191,796
Washington	317,984,449	524,932,234
West Virginia	223,807,858	75,500,713
Wisconsin*	137,445,172	318,187,261
Wyoming*	21,263,970	6,056,131
Total	$ 17,349,008,376	$ 21,387,060,896
Total available through EBT	$ 17,349,008,376	$ 19,054,702,505

TANF expenditures include both the federal and state maintenance-of-effort (MOE) funds. TANF expenditures are available from the U.S. Office of Family Assistance. SNAP expenditures are available from the U.S. Department of Agriculture. Amounts presented are averaged from the years 1997 through 1999. * indicates TANF payments are not available through the state's EBT program.

APPENDIX D: VARIABLE DEFINITIONS

Variable	Definition	Source[†]
AGE	Average age group of survey respondents by MSA. Age groups are identified in ten year increments from 15 to 64 years and then as 65 years or more.	FDIC
BUSINESS INCOME	Business or professional income amount (in thousands) divided by the number of returns with business or professional income reported by MSA.	IRS
DIVIDENDS	Ordinary dividends amount (in thousands) divided by the number of returns with dividends reported by MSA.	IRS
DIVIDENDS AND INTEREST	Dividends, interest, and rental income amount (in thousands) divided by the number of persons by county.	BEA
EBT	Indicator variable equal to one for time periods after the implementation of an EBT program and zero otherwise.	
EMPLOYMENT	Total employment, number of jobs, divided by the number of persons by county	BEA
EMPLOYMENT RATE	Percentage of survey respondents identified as employed by MSA.	FDIC
GROSS INCOME	Natural log of reported adjusted gross income (in thousands)	IRS
INTEREST	Taxable interest amount (in thousands) divided by the number of returns with taxable income reported by MSA.	IRS
LOAN AMOUNT	Amount of SBA 7(a) loans divided by the number of loans issued by county	SBA
LOAN CHARGEOFF	Amount of SBA 7(a) loan balances charged off divided by the number of loans issued by county	SBA
LOAN COUNT	Number of SBA 7(a) loans issued by county	SBA
POPULATION	Population in number of persons by county (in thousands)	BEA

RETIREMENT	Retirement income amount (in thousands) divided by the number of persons by county.	BEA
SALARY AND WAGE	Salaries and wages amount (in thousands) divided by the number of returns with salaries and wages reported by MSA.	IRS
STATE GDP	Gross domestic product (in billions) by state	BEA
SUPPLEMENTAL	Supplements to wages and salaries, employer contributions for employee pensions and insurance funds, (in thousands) divided by the number of persons by county.	BEA
TAXABLE SALES	Natural log of reported taxable sales	Missouri Department of Revenue
TRANSFER RECEIPTS	Transfer receipts, benefits received for which no services are performed, (in thousands) divided by the number of persons by county.	BEA
UNDERBANKED	Percentage of survey respondents identified as underbanked by MSA.	FDIC
WAGE	Wages and salaries amount (in thousands) divided by the number of persons by county.	BEA

†FDIC: https://www.economicinclusion.gov/
IRS: https://www.irs.gov/statistics/soi-tax-stats-county-data
BEA: https://www.bea.gov/data/income-saving/personal-income-county-metro-and-other-areas
SBA: https://www.sba.gov/about-sba/open-government/foia#section-header-32

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